Prototype: Smart Charging Service

Makes E-Mobility more attractive by charging when electricity is cheaper (actual load on the grid is lower than the forecast)

(Future work: charge based on predicted battery usage)
Challenge 1  Develop innovative services for first / last mile integration of the Schaeffler eBoard into the public transport network, e.g.: user friendly booking / sharing / billing services, autonomous delivery & parking, charging solutions.

Challenge 2  Optimize the safety of the Schaeffler eBoard for applications at work, leisure or sports, by e.g.: environment recognition systems, V2X communication or adaptive speed / power limitations!

Presented by SCHAEFFLER
## Charging Logic

<table>
<thead>
<tr>
<th>Battery Status</th>
<th>Grid Load &lt; Forecast</th>
<th>Grid Load &gt; Forecast</th>
</tr>
</thead>
<tbody>
<tr>
<td>Battery &gt; 50%</td>
<td>Start Charging</td>
<td>Wait</td>
</tr>
<tr>
<td>Battery &lt; 50%</td>
<td>Start Charging</td>
<td>Start Charging</td>
</tr>
</tbody>
</table>
List of needed services

1) eBoard Service: provide charge-related sensor data from the board
2) Grid Actual Load / Load Forecast Service: provide grid data
3) Forecast Service: extrapolate “Actual Load” 60 Minutes into the Future
4) Rule Service: decide “charge” / “don’t charge” based on
   a) power grid data
   b) board data
5) Actuator service: switch the charger on / off
<table>
<thead>
<tr>
<th>Name</th>
<th>Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>Actual Load</td>
<td>published</td>
</tr>
<tr>
<td>Actual Load of Power Grid</td>
<td></td>
</tr>
<tr>
<td>Charging Station Switch</td>
<td>published</td>
</tr>
<tr>
<td>receives switch ON/OFF</td>
<td></td>
</tr>
<tr>
<td>commands</td>
<td></td>
</tr>
<tr>
<td>Load Forecast</td>
<td>published</td>
</tr>
<tr>
<td>Predicted Value For Power</td>
<td></td>
</tr>
<tr>
<td>Grid</td>
<td></td>
</tr>
<tr>
<td>Prediction Service</td>
<td>uncomplete</td>
</tr>
<tr>
<td>Schaeffler eBoard</td>
<td>published</td>
</tr>
<tr>
<td>provides Schaeffler eBoard data</td>
<td></td>
</tr>
<tr>
<td>Schaeffler eBoard Battery</td>
<td>published</td>
</tr>
<tr>
<td>provides battery level</td>
<td></td>
</tr>
<tr>
<td>data</td>
<td></td>
</tr>
</tbody>
</table>

Source: [Smart Orchestra Demo Instance](https://smartorchestra.de) (active during the Hackathon only)
Front End View (Dashboard)

Source: Smart Orchestra Demo Instance (active during the Hackathon only)
Prototype Overview

- Charging Station Service
- Rules Service
- Battery Level
- Power Grid Service
- eBoard Service

SmartOrchestra Platform

Switch ON/OFF
Reads Battery Level and Power Grid information and generates commands for Charging Station
Power Grid Load Forecast, Power Grid Actual Load
Open Energy Grid Data

Source: ENTSOE Transparency Portal
Open Energy Grid Data

Source: ENTSOE Transparency Portal
Forecasting Service

Prophet is a forecasting procedure implemented in R and Python. It is fast and provides completely automated forecasts that can be tuned by hand by data scientists and analysts.

Source: https://facebook.github.io/prophet/
Status of services

1) eBoard Service: provide charge-related sensor data from the board
   (Done; python-based client)
2) Grid Actual Load / Load Forecast Service: provide grid data
   (Done, dockerized python application)
3) Forecast Service: extrapolate “Actual Load” 60 Minutes into the Future
   (Work in Progress)
4) Rule Service: decide “charge” / “don’t charge” based on
   a) power grid data
      (Done, dockerized python application)
   b) board data
      (Work in Progress)
5) Actuator service: switch the charger on / off
   (Done, python-based client)